

NHRC UPDATE

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This update is being published quarterly to highlight NHRC contributions to the Navy and the broader scientific community.

NHRC Research Reduces Recruit Training Injuries and Costs

Although the benefits of physical activity and exercise are well documented, these activities are also known to incur certain risks. Musculoskeletal injury, for example, is the most common morbidity in civilian and military populations who participate in sports and exercise. These injuries are a leading cause of patient visits, lost training time, and reduced operational readiness in U.S. military forces. In recent studies at NHRC, LCDR



Recruit physical training at MCRD

Rick Shaffer and his colleagues have documented that approximately one half of the women and one third of the men are injured during recruit training in the Marine Corps. At the Marine Corps Recruit Depot, San Diego, previous NHRC research demonstrated an annual loss of 53,600 injury-related training days at a cost in excess of \$16 million.

Working closely with Marine Corps, Navy, and Special Operations personnel, LCDR Shaffer, CAPT Brodine, Dr. Almeida, and their colleagues have fielded an aggressive research program to reduce the incidence of musculoskeletal injuries. This approach involves the development and deployment of data collection systems at major training facilities to document the incidence and nature of the injuries, the development of risk factor profiles for injury susceptibility, and the development and evaluation of interventions to reduce injuries. To

accomplish these objectives, the NHRC researchers have assembled a sophisticated, multidisciplinary team of Navy sports medicine and operational experts and research partners from Johns Hopkins University, University of California, and Children's Hospital, San Diego.

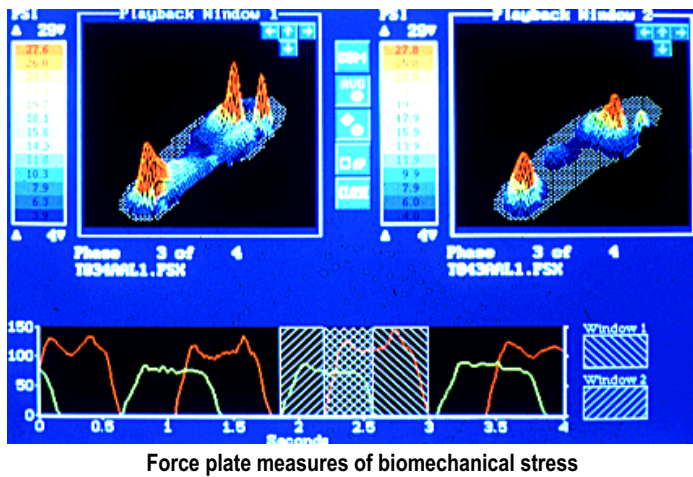
In a recent article in the *Journal of Bone and Mineral Research*, Dr. Beck and his Johns Hopkins' colleagues, in concert with LCDR Shaffer, Karen Maxwell-Williams, and CAPT Brodine of NHRC, used dual-energy x-ray absorptiometry (DEXA) to derive structural bone geometry as a potential predictor of stress fractures among Marine Corps recruits. These authors concluded that both small body



DEXA scan of bone geometry

weight and small dimensions of the long bone shaft (diaphyseal) relative to body weight are factors predisposing to the development of stress fractures in this population. Poor physical fitness at time of entry into recruit training also has been identified by LCDR Shaffer and his colleagues as a strong predictor of injury. This and other information derived from the injury monitoring program has led to the development of a scientifically based intervention to reduce injuries at the Marine Corp Recruit Depot. An evaluation of this intervention demonstrated an overall reduction in over-use injuries and a 50% reduction in stress fractures, with no decrement in physical fitness at graduation. Current efforts are focused on the development of improved footwear and the development of interventions to reduce injuries at the Naval Recruit Training Center, Great

Lakes, at the Marine Corps Recruit Depot, Parris Island, and at various operational commands.



NHRC Physiologists Assess Body Composition Links to Physical Performance and Health

NHRC's research on health and physical performance has played a crucial role in setting Navy fitness standards. Previous NHRC studies on body composition measurement techniques established the Center's prediction equations for body fat percentage as the standard used by the Navy and the Air Force. Recently, in an attempt to identify effective predictors of physical performance, Dr. James Hodgdon and his team of researchers performed a study using bioelectrical impedance to measure body composition.

As part of the Department of Defense's weight control policy, DoD Directive 1308.1 indicated that "the determining factor in deciding whether a service member is overweight is the member's percent of body fat." The Bureau of Naval Personnel updated its physical fitness and weight control programs to follow this Directive, and tasked NHRC with developing field techniques for estimating body fat content. The current tables used to estimate body fat from circumferences and height were developed by NHRC and incorporated into the Physical Readiness Instruction. Also, NHRC developed techniques for estimating body fat content. In the process, NHRC concluded that body fat is not strongly related to the performance of physical job tasks,

and that the primary rationale for setting body composition standards is the relationship of body fat to health. The National Institutes of Health determined health risks associated with excess body fat are elevated when individuals exceed the optimum weight for height on the Metropolitan Life Insurance Co. tables by 20%, and it defines obesity as 20% above the life insurance table values. NHRC has determined that these weights are equivalent to a single percent body fat value for each gender, and these values, 22% fat for men and 33% fat for women, provide the basis for the Navy body fat standards.

Physical strength remains a critical component of many tasks required of sailors. However, job selection standards based on strength tests are difficult to apply because of the specificity of individual strength tests, injury risks, and poor portability of testing equipment. An alternative approach that may overcome all three of these limitations is to predict strength performance through one of its primary determinants, fat-free mass (i.e., muscle and bone mass). Dr. Hodgdon and his colleague, Marcie Beckett, previously have shown fat-free mass, estimated from circumferences and height, to be strongly associated with performance on lifting tasks. Fat-free mass is effectively predicted by expedient methods, using analyses based on skinfold thickness and body density.

In the most recent study, Hodgdon and Beckett, and researchers at the U.S. Army Research Institute of Environmental Medicine, have examined the effectiveness of bioelectrical impedance analysis (BIA) measurements as predictors of physical performance. Through its association with fat-free mass, BIA offers the possibility of a noninvasive and reproducible technique that may be associated with strength performance. The study examined the relationship between BIA measures, fat-free mass, and muscular strength. The relationships in this triad were tested in Navy men and women in a cross sectional study: Army women before and after eight



weeks of basic combat training, and Army Ranger students before and after eight weeks of Ranger training. The research study, to be published in October 1996 as a supplement to the *American Journal of Clinical Nutrition*, reports that BIA is valid as an indicator of fat-free mass and changes in fat-free mass only in situations wherein water and nutritional balance are maintained. In short, BIA does not appear to be particularly useful for performance prediction despite its moderate relationship to fat-free mass. NHRC is continuing research in alternative approaches to physical performance prediction.

civilian work force employed at each facility over the past seven years. The analytic and display software provides statistical adjustment procedures to enable comparisons across diverse worksites and populations, develops models for estimating costs, generates information for developing intervention strategies, and provides critical outcome measures for evaluation.

In a recent article published in the *Journal of Occupational and Environmental Medicine*, July 1996, NHRC researchers Steve Shepherd and Bonnie LaFleur used this approach to demonstrate excessive Monday workplace injuries among Department of the Navy civilian employees. After examining more than 55,802 injury claims from 1989 to 1994, these researchers found that the rate of Monday sprains and strains, particularly of the back or trunk, significantly exceeded the expected rate and that such claims were more likely to be made by supervisors who were craftsmen and mechanics without college degrees. They estimated that 22% of claims for Monday-occurring sprains and strains are possibly fraudulent, and suggested that about 1,500 of these claims are unrelated to safety conditions at Navy facilities. The fact remains, however, that these claims for the six years studied have generated costs and future liabilities for the Navy in excess of \$38 million. The cost to private industry insurers for fraudulent sprains and strains alleged to have occurred on Mondays has been estimated at between \$175 and \$185 million annually.

Currently, this powerful technology, developed by NHRC and referred to as the Occupational Safety and Health System (OSHSYS), is being placed on CD-

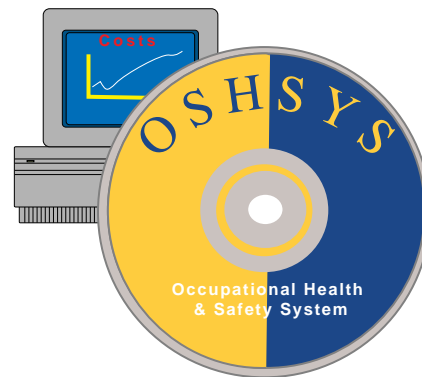
ROM so it can be migrated closer to the worksite. Karen Freeman, Jennifer Jaeger, Hoa Ly, and Dr. Ivan Show are continuing this NHRC effort to help policy-makers and safety managers track and assess,

manage, and control the occurrence of workplace illnesses and injuries and their attendant costs in medical care and compensation.

NHRC Scientists Strive to Reduce Navy Occupational Injuries and Cut Costs

Each year, the Department of the Navy is responsible for approximately one seventh of the federal government's total workers' compensation bill, which in 1993 cost the Navy more than \$250 million. In 1990 alone, 20,364 civilians working in Navy facilities were injured on the job, and these injuries are projected to cost \$382 million in lost wages, medical costs, and workers' compensation payments over the duration of the claims. With a work force of more than a quarter of a million civilian employees serving in over 2,000 facilities, the Navy faces a complex task in reducing the occurrence and costs of occupational injuries.

In response to this challenge, researchers at NHRC have been developing powerful database tools and software systems to assist the Navy Occupational Safety and Health Program Manager in analyzing workplace injuries and illnesses, pinpointing risk factors to guide the development of better intervention and control measures, and evaluating the effectiveness of worksite changes. These database tools draw from complex, diverse sources, such as the U.S. Department of Labor's Office of Worker's Compensation Program and the Department of the Navy Civilian Personnel Data System Center, to compile comprehensive information on injury incidence, injury costs, and demographic, occupational, and career data on the



Technology Transfer...

NHRC Assists Investigators of ValuJet Crash

The Naval Health Research Center (NHRC) is providing technical assistance to the National Transportation and Safety Board (NTSB) as the crash site investigation of ValuJet Flight 592 continues in the Florida Everglades.



Crash site investigation team

In coordination with the Naval Science Assistance Program (NSAP), researchers from NHRC are sharing information and technology used to protect Navy and Marine Corps personnel who frequently operate for extended periods in adverse environments and in protective clothing ensembles that increase body temperature.

At the request of the NTSB and Susan Bales, Director of NSAP, Jay Heaney, a research physiologist at NHRC, has flown to the crash site with 14 Steele Ice Vests™. Heaney has briefed the divers and ground-based personnel on the proper use of the ice vests to reduce thermal stress and extend stay times.

NHRC has proved these ice vests are effective

in military situations such as the Persian Gulf, firefighting, and damage control operations, and are now in the inventories of most Navy ships.

As in many military operations, the investigators at the crash site are operating at the upper limits of human endurance and environmental extremes. The assistance of Navy Medicine will contribute measurably to the accomplishment of this enormous and difficult task.



NTSB worker with ice vest before donning biohazard suit

NHRC Launches Home Page on the World Wide Web

The NHRC home page was developed to further enhance the transfer of research and development information. Through this window to the world, NHRC organizational information is available at the department, division, work unit, and individual level. The home page also provides access to the latest scientific information through abstracts of NHRC publications and links to other relevant resources. Last month this home page was accessed by nearly 16,000 individuals from more than 30 countries around the world. For further information about NHRC and a copy of this and other "updates," you are invited to visit our home page @ <http://www.nhrc.navy.mil>.

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